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(54) **IMAGE FORMING APPARATUS PERFORMING STABILIZATION ON IMAGE DATA**

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G03G 15/00 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/50*** (2013.01); *G03G 15/505* (2013.01); *G03G 15/6544* (2013.01); *G03G 2215/00827* (2013.01); *G03G 2215/0132* (2013.01)

(58) **Field of Classification Search**
CPC G03G 15/50; G03G 15/55
See application file for complete search history.

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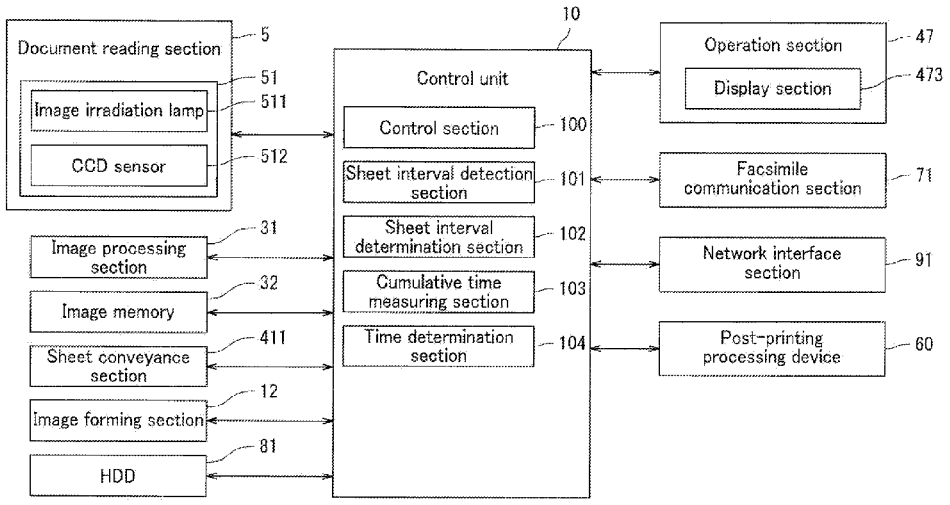
(57) **ABSTRACT**

An image forming section forms a printed image on paper based on image data. A post-printing processing section performs post-printing processing on the paper. A stabilization section performs stabilization on image data. A sheet interval detection section detects a sheet interval between consecutive sheets being conveyed in the post-printing processing section. A sheet interval determination section determines whether or not the sheet interval exceeds a reference period of time. A cumulative time measuring section measures a cumulative total time of an image formation operation. A time determination section determines whether or not the cumulative total time exceeds a predetermined period of time. A control section controls, upon determination that the cumulative total time exceeds the predetermined period of time and the sheet interval exceeds the reference period of time, the stabilization section to perform the stabilization during the sheet interval exceeding the reference period of time.

7 Claims, 4 Drawing Sheets



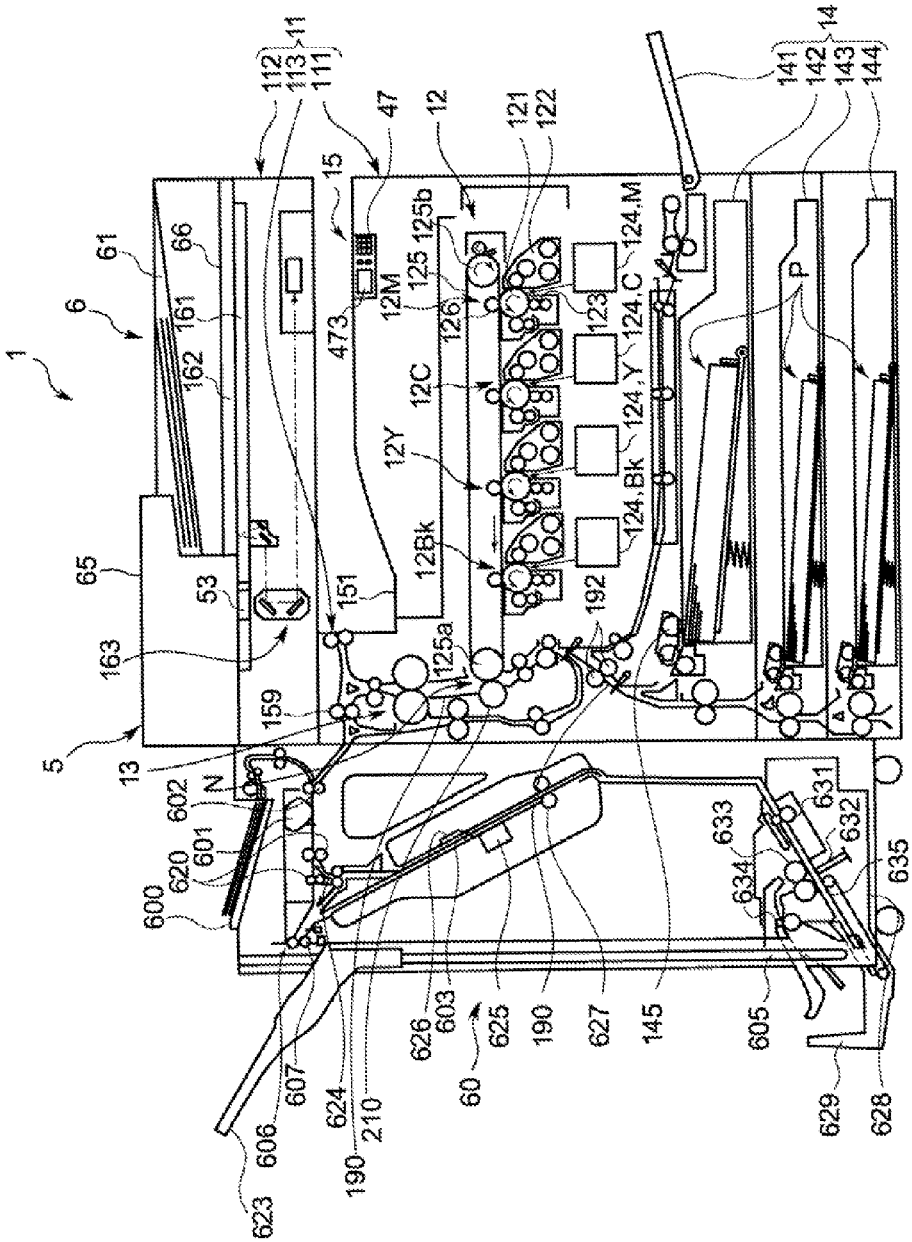

1
5
6
11
12
13
14
15
47
53
60
61
65
66
111
112
113
121
122
123
124,M
124,C
124,Y
124,Bk
125
125a
125b
126
12M
12C
12Y
12Bk
141
142
143
144
145
151
159
161
162
163
190
192
210
473
600
601
602
603
605
606
607
620
623
624
625
626
627
628
629
631
632
633
634
635
N
P

FIG. 1

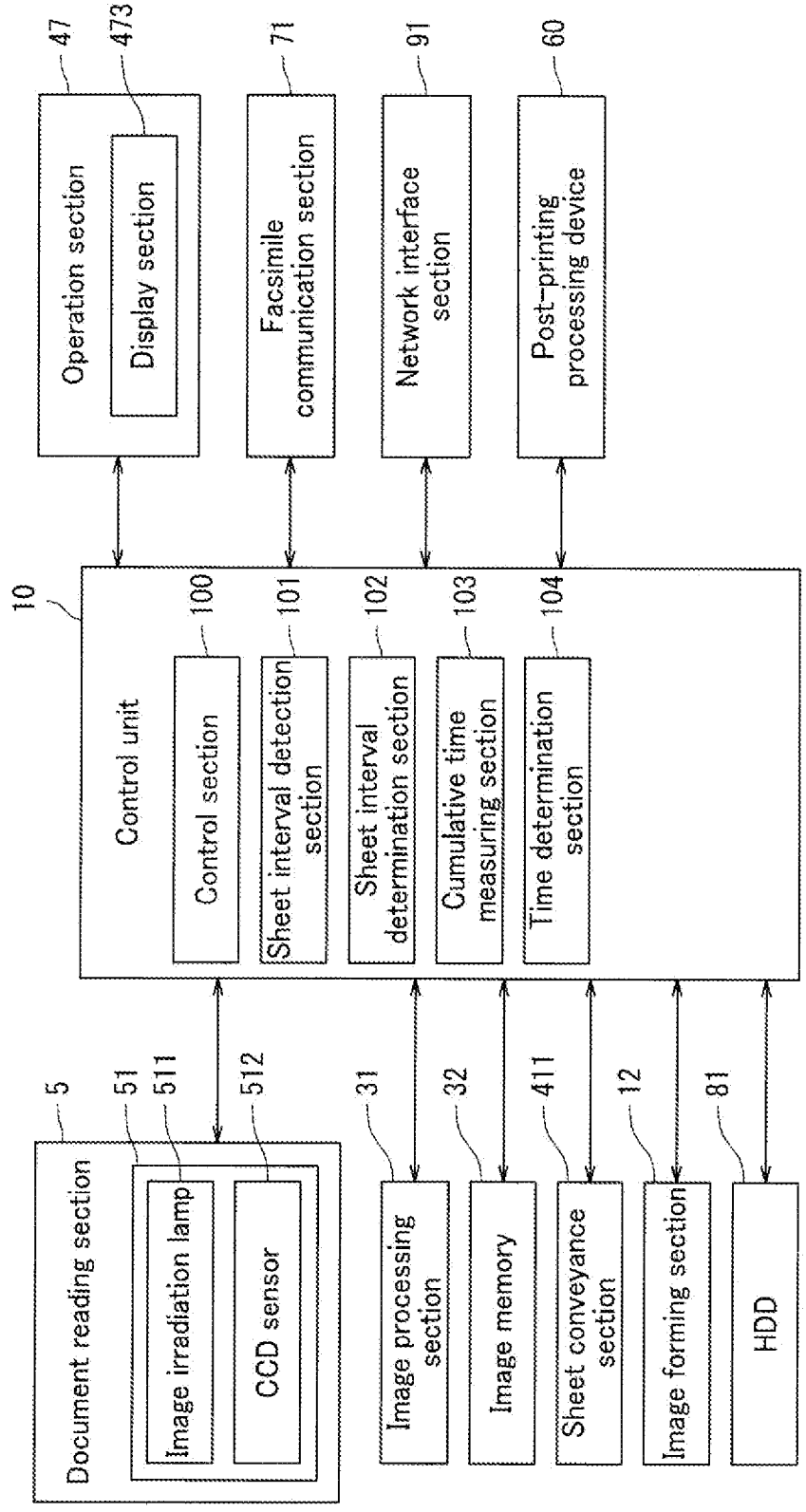

47
473
71
91
60
Operation section
Display section
Facsimile communication section
Network interface section
Post-printing processing device
10
Control unit
100
101
102
103
104
Control section
Sheet interval detection section
Sheet interval determination section
Cumulative time measuring section
Time determination section
5
51
511
512
31
32
411
12
81
Document reading section
Image irradiation lamp
CCD sensor
Image processing section
Image memory
Sheet conveyance section
Image forming section
HDD

FIG. 2

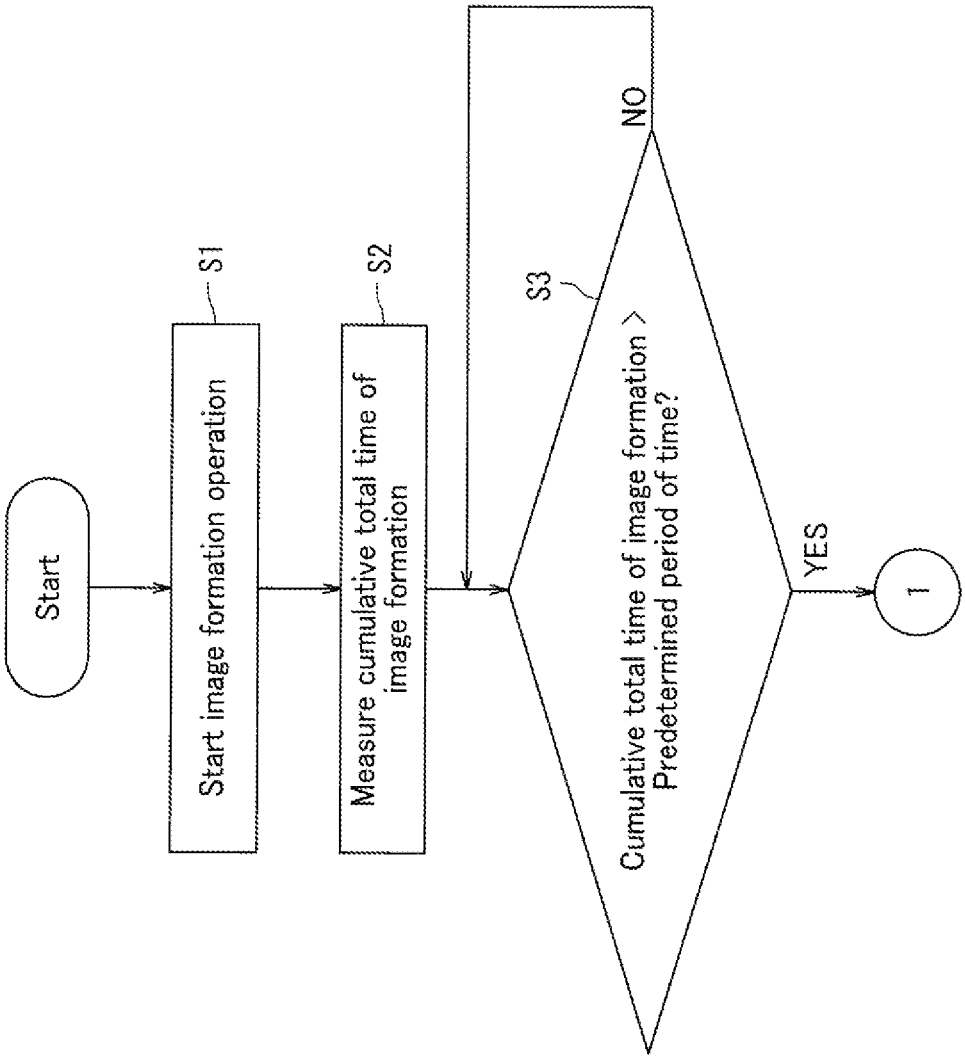

Start
Start image formation operation
S1
Measure cumulative total time of image formation
S2
S3
Cumulative total time of image formation > Predetermined period of time?
NO
YES
1

FIG. 3

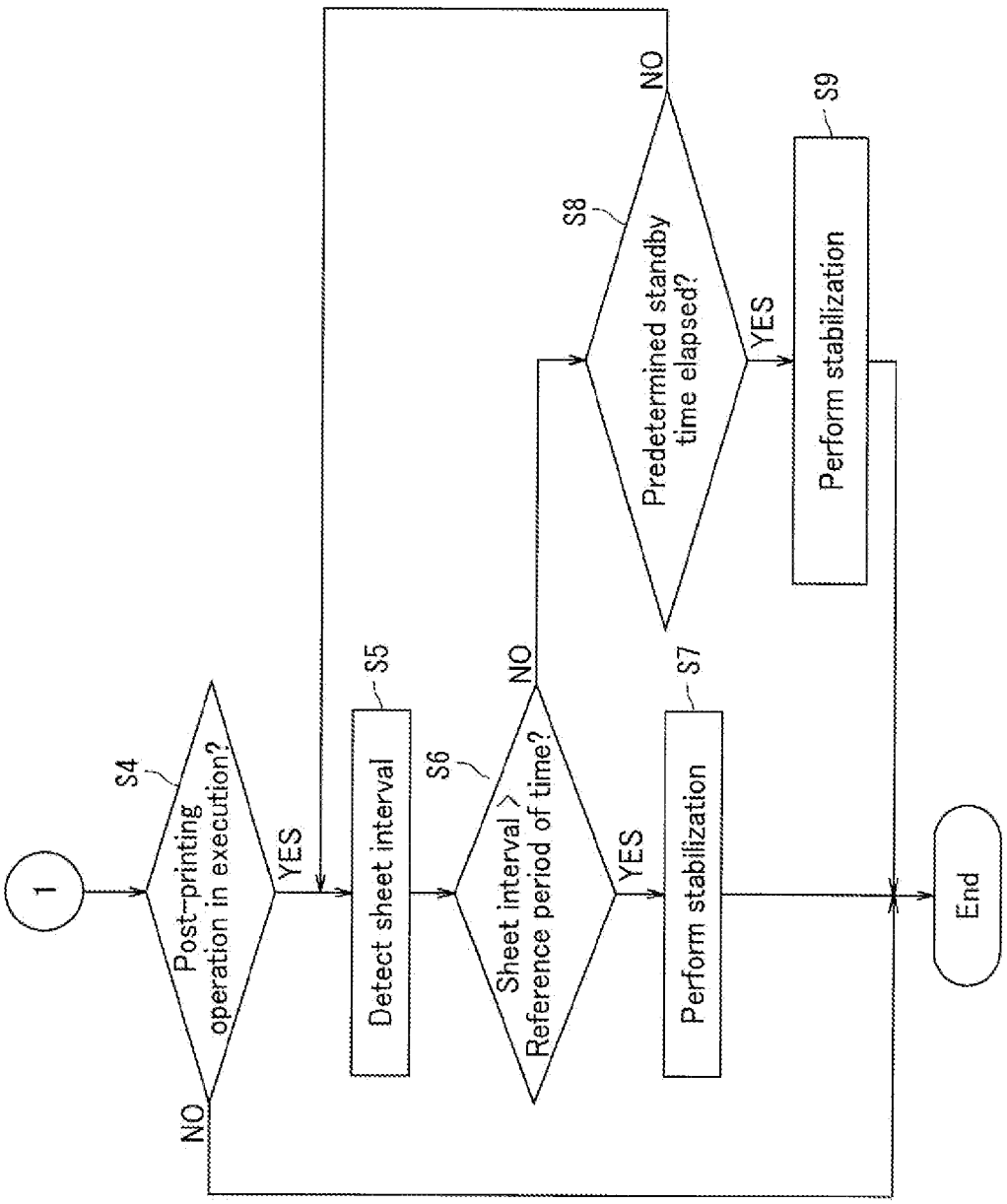

1
S4
Post-printing operation in execution?
YES
NO
S5
Detect sheet interval
S6
Sheet interval > Reference period of time?
NO
YES
S7
Perform stabilization
S8
Predetermined standby time elapsed?
NO
YES
S9
Perform stabilization
End

FIG. 4

IMAGE FORMING APPARATUS PERFORMING STABILIZATION ON IMAGE DATA

INCORPORATION BY REFERENCE

The present application claims priority under 35 U.S.C. §119 to Japanese Patent Application No. 2014-087372, filed Apr. 21, 2014. The contents of this application are incorporated herein by reference in their entirety.

BACKGROUND

The present disclosure relates to an image forming apparatus. More particularly, the present disclosure relates to a technique for performing stabilization on an image.

General image forming apparatuses perform stabilization on image data in order to achieve a high-quality image. The stabilization is to perform calibration (color density adjustment) on image data according to change in the environment within the image forming apparatus and/or frequency of use of the image forming apparatus, for example. Accordingly, image formation processes are adjusted to be optimal.

For example, some image forming apparatus are capable of appropriate image stabilization. Such image forming apparatuses include a calculating section. The calculating section calculates, upon detecting disturbance during an electrophotographic process, a breakdown for the operating time of their image forming unit on the assumption that image stabilization control has been performed.

Based on the calculation result, it is verified whether or not the ratio of the time taken to perform the stabilization control to the cumulative total of the operating time is equal to or less than a predetermined ratio. If the ratio of the time taken to perform the stabilization control to the cumulative total of the operating time is equal to or less than the predetermined ratio, the image stabilization control is performed. On the other hand, when the ratio of the time taken to perform the stabilization control to the cumulative total of the operating time is greater than the predetermined ratio, timing of the stabilization control is changed so that the ratio of the time taken to perform the stabilization control is equal to or less than the predetermined ratio. As a result, control of the image forming unit is completed without performing the stabilization control. The stabilization control is performed in the next or following operation of the image forming unit.

SUMMARY

An image forming apparatus according to an aspect of the present disclosure includes an image forming section, a post-printing processing section, a stabilization section, a sheet interval detection section, a sheet interval determination section, a cumulative time measuring section, a time determination section, and a control section. The image forming section forms a printed image on paper based on image data. The post-printing processing section performs post-printing processing on the paper or an original document. The stabilization section performs stabilization on image data. The sheet interval detection section detects as a sheet interval a time interval between a trailing end of a preceding sheet of paper and a leading end of a following sheet of paper among consecutive sheets of paper being conveyed in the post-printing processing section or a time interval between a trailing end of a preceding original document sheet and a leading end of a following original document sheet among consecutive original document sheets being conveyed in the post-printing processing section while the post-printing processing section is performing the post-printing processing. The sheet interval determination section determines whether or not the sheet interval detected by the sheet interval detection section exceeds a reference period of time. The cumulative time measuring section measures a cumulative total time of an image formation operation performed by the image forming section. The time determination section determines whether or not the cumulative total time measured by the cumulative time measuring section exceeds a predetermined period of time. Upon the time determination section determining that the cumulative total time exceeds the predetermined period of time and the sheet interval determination section determining that the sheet interval exceeds the reference period of time, the control section controls the stabilization section to perform the stabilization during the sheet interval determined to be exceeding the reference period of time.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front cross sectional view illustrating a structure of an image forming apparatus according to an embodiment of the present disclosure.

FIG. **2** is a functional block diagram illustrating internal configuration of the image forming apparatus.

FIG. **3** is a flowchart illustrating a first half of stabilization control based on a sheet interval of sheets of paper conveyed to a post-printing processing device.

FIG. **4** is a flowchart illustrating a last half of the stabilization control based on the sheet interval of sheets of paper conveyed to the post-printing processing device.

DETAILED DESCRIPTION

Hereinafter, an image forming apparatus according to an embodiment of the present disclosure will be described with reference to the accompanying drawings. FIG. **1** is a diagram illustrating a structure of an image forming apparatus according to the embodiment of the present disclosure.

An image forming apparatus **1** according to the embodiment of the present disclosure has a function such as a copy function, a printer function, a scanner function, or a facsimile function, for example. The image forming apparatus **1** may be a multifunction peripheral. In this case, the image forming apparatus **1** has at least two or more functions of a copy function, a printer function, a scanner function, and a facsimile function, for example. The image forming apparatus **1** includes a main body **11**, an image forming section **12**, a fixing section **13**, a paper feed section **14**, a paper ejection section **15**, a document conveyance section **6**, a document reading section **5**, and so on. The image forming apparatus **1** further includes a post-printing processing device **60**. The post-printing processing device **60** is an example of the post-printing processing section recited in the appended claims.

The main body **11** includes a lower body **111**, an upper body **112**, and a coupling section **113**. The upper body **112** is disposed above the lower body **111**, facing the lower body **111**. The coupling section **113** is disposed between the upper body **112** and the lower body **111**. The coupling section **113** couples the lower body **111** and the upper body **112** together with the paper ejecting section **15** between the lower body **111** and the upper body **112**. The upper body **112** is supported on an upper end of the coupling section **113**. The upper body **112** includes the document reading section **5** and the document conveyance section **6**.

The document reading section **5** includes a contact glass **161**, a platen cover **162**, and a reading mechanism **163**. The

contact glass **161** is attached to an upper surface of the upper body **112**. The platen cover **162** is openable and closable, and presses an original document placed on the contact glass **161**. The reading mechanism **163** optically reads an image on an original document placed on the contact glass **161** and generates image data using a charge coupled device (CCD).

The document conveyance section **6** includes a document table **61**, a document ejection section **66**, and a document conveying mechanism **65**. An original document is placed on the document table **61**. An original document from which an image has been read is ejected onto the document ejection section **66**. The document conveying mechanism **65** includes a sheet feed roller, a conveyance roller, and a sheet reversing mechanism, not shown. The document conveying mechanism **65** picks up original document sheets placed on the document table **61** one by one using the sheet feed roller and conveys the original document sheets to a position opposite to a document reading slit **53** using the conveyance roller. The reading mechanism **163** reads an image on the original document through the document reading slit **53**. Thereafter, the original document sheets are ejected onto the document ejection section **66**.

The document conveyance section **6** is rotatably attached to the upper body **112** so that a front side of a document conveyance section **6** in FIG. **1** can move upward. A user can place an original document to be read on a top surface of the contact glass **161** serving as a platen by moving the front side of the document conveyance section **6** upward and thus uncovering the top surface of the contact glass **161**. The original document to be read is for example a folded-open book.

The lower body **111** includes the image forming section **12**, the fixing section **13**, and the paper feed section **14**. The paper feed section **14** has a manual feed tray **141** and paper feed cassettes **142**, **143**, and **144**. The manual feed tray **141** is disposed to be openable and closable in a lower location of a right side wall of the main body **11** in FIG. **1**. The manual feed tray **141** is a tray from which paper P is manually fed toward the image forming section **12**. The paper feed cassettes **142**, **143**, and **144** are detachably attached to the main body **11** in locations lower than exposure devices **124** in the lower body **111**. The paper feed cassettes **142**, **143**, and **144** each contain a stack of paper including a plurality of sheets of paper P.

Pickup rollers **145** are disposed above the respective paper feed cassettes **142**, **143**, and **144**. Each of the pickup rollers **145** picks up and sends toward a sheet conveyance path **190** a topmost sheet of paper P out of the stack of paper contained in the paper feed cassettes **142**, **143**, and **144**.

In an image formation operation by the image forming apparatus **1**, the image forming section **12** forms a printed image on a paper P fed from the paper feed section **14** based on image data generated through the above-described document reading or on image data stored in an internal HDD. Image forming units **12**M, **12**C, **12**Y, and **12**Bk of the image forming section **12** each include a photosensitive drum **121**, a charger **123**, the exposure device **124**, the developing device **122**, and a primary transfer roller **126**.

The developing devices **122** of the image forming units **12**M, **12**C, **12**Y, and **12**Bk each contain toner for developing an electrostatic latent image. Each developing device **122** supplies the toner to a surface of the corresponding photosensitive drum **121** charged by the charger **123** and exposed to light by the exposure device **124**.

In the case of color printing, the image forming unit **12**M for a magenta color, the image forming unit **12**C for a cyan color, the image forming unit **12**Y for a yellow color, and the image forming unit **12**Bk for a black color of the image forming section **12** perform charging, light exposure, and development based on image data formed from components of the respective colors. Thus, a toner image is formed on a surface of each photosensitive drum **121**. The primary transfer rollers **126** transfer the toner images onto an intermediate transfer belt **125**.

The intermediate transfer belt **125** stretches between a drive roller **125***a* and a driven roller **125***b*. An outer circumferential surface of the intermediate transfer belt **125** functions as an image bearing surface onto which toner images are transferred. The intermediate transfer belt **125** is rotated by the drive roller **125***a* while in contact with peripheral surfaces of the respective photosensitive drums **121**. The intermediate transfer belt **125** is endless and travels between the drive roller **125***a* and the driven roller **125***b* in synchronization with the respective photosensitive drums **121**.

The toner images of the respective colors are transferred onto the intermediate transfer belt **125** in a timed manner. The toner images of the respective colors are superimposed on the intermediate transfer belt **125** to be a color toner image. A secondary transfer roller **210** and the drive roller **125***a* form a nip section N with the intermediate transfer belt **125** therebetween. The secondary transfer roller **210** transfers the color toner image formed on the intermediate transfer belt **125** onto paper P conveyed to the nip section N from the paper feed section **14** through the conveyance path **190**. Thereafter, the fixing section **13** fixes the color toner image transferred onto the paper P by thermocompression bonding. The paper P on which the color image has been formed through the fixing is ejected onto an exit tray **151**.

The paper ejection section **15** is formed between the lower body **111** and the upper body **112**. The paper ejection section **15** includes the exit tray **151** formed on a top surface of the lower body **111**. Paper P that has gone through the toner image formation in the image forming section **12** and the fixing in the fixing section **13** is ejected onto the exit tray **151**.

The post-printing processing device **60** includes a document table **600**, a punch section **601**, a pair of conveyance rollers **602**, a sheet cradle **603**, a pair of conveyance rollers **620**, a pair of ejection rollers **607**, a sheet exit tray **623**, and a conveyance diverging guide **624**. The post-printing processing device **60** further includes a stapler **625**, a receiving member **626**, a pair of conveyance rollers **627**, a bookbinding section **628**, and an exit tray **629**. The post-printing processing device **60** performs post-printing processing on paper P. For example, the post-printing processing device **60** may be a finisher. In post-printing processing that is performed by the finisher, a longer sheet interval is needed. The post-printing processing may be at least one of stapling, punching, sorting, and folding.

An original document on which the post-printing processing device **60** is to perform the post-printing processing is placed on the document table **600**. The punch section **601** performs punching on a sheet conveyed thereto by a pair of ejection rollers **159** of the main body **11** or conveyed thereto from the document table **600** (e.g., paper P on which a printed image has been formed or an original document placed on the document table **600**). The punching refers to processing for cutting a hole in a sheet conveyed to the punch section **601**. The punching needs a halt of sheet conveyance for cutting a hole in a sheet. Accordingly, the punching makes the sheet interval longer. When a plurality of holes are cut in a sheet along the sheet conveyance direction, the sheet conveyance is halted for every hole cutting. Accordingly, the sheet interval is still longer when a plurality of holes are cut in a sheet. The sheet interval refers to a period of time from when a trailing end of a preceding sheet of paper P passes a predetermined

point to when a leading end of a following sheet of paper P passes the predetermined point. The sheet cradle **603** temporarily holds paper or an original document conveyed thereto by the pairs of conveyance rollers **602** and **620**. When a plurality of sheets of paper or a plurality of original document sheets are conveyed, they are held by the sheet cradle **603** in a stack.

The pair of ejection rollers **607** is disposed at a sheet exit slot **606** through which paper conveyed from the post-printing processing device **60** is ejected. The pair of ejection rollers **607** ejects paper conveyed thereto from the pairs of conveyance rollers **602** and **620**, and paper conveyed thereto from the sheet cradle **603** onto the sheet exit tray **623**. A lifter **605** goes up and down to lift up and down the sheet exit tray **623**. The sheet exit tray **623** receives, at a sheet receiving position in the vicinity of the sheet exit slot **606**, paper ejected by the pair of ejection rollers **607** through the sheet exit slot **606**. Paper ejected through the sheet exit slot **606** is placed on the sheet exit tray **623**.

The stapler **625** performs stapling on sheets of paper conveyed to the sheet cradle **603**. The stapling is to staple sheets of paper and eject a stack of paper. Ejection of a stack of paper takes more time than ejection of unprocessed paper does, making the sheet interval longer. The receiving member **626** receives and holds a lower end of paper conveyed to the sheet cradle **603**. The pair of conveyance rollers **627** conveys paper downward from the sheet cradle **603**. The bookbinding section **628** performs folding on paper conveyed thereto from the pair of conveyance rollers **627**. Folded paper is ejected onto the exit tray **629**. Folding is to center-fold and bind sheets of paper into a booklet, and then eject the booklet. Ejection of a booklet takes more time than ejection of unprocessed paper does, making the sheet interval longer.

The sheet cradle **603** includes a drive section (not shown) that moves the receiving member **626** in the sheet conveyance direction. The drive section is driven in accordance with a control signal from a drive control section (not shown). As a result, paper held by the receiving member **626** is conveyed to the pair of ejection rollers **607**. The paper conveyed by the pair of ejection rollers **607** is ejected onto the sheet exit tray **623** through the sheet exit slot **606**.

The stapler **625** is movable in accordance with the drive section. The drive section is driven in accordance with a control signal from the drive control section. In performing normal stapling on paper conveyed to the sheet cradle **603**, the stapler **625** is moved to a position close to an end of paper and staples the paper at the position close to the end. In performing bookbinding on paper, the stapler **625** is moved to a position close to a center of the paper and staples the paper at the position close to the center for saddle stitch.

The bookbinding section **628** includes a center-stapled sheet table **635**, a pair of conveyance rollers **631**, a pushing member **632**, a pair of center-folding rollers **633**, and a pair of ejection rollers **634**. Paper center-stapled by the stapler **625** is placed on the center-stapled sheet table **635**. The pair of conveyance rollers **631** conveys paper conveyed thereto from the pair of conveyance rollers **627** to the center-stapled sheet table **635**. The pushing member **632** and the pair of center-folding rollers **633** are disposed opposite to each other, having the center and the vicinity thereof of the paper on the center-stapled sheet table **635** therebetween in such a manner that the former is in contact with one side of the paper and the latter is in contact with the other side of the paper. The pair of center-folding rollers **633** center-folds the paper into a saddle-stitched booklet, and the pair of ejection rollers **634** ejects the booklet onto the exit tray **629**.

The lifter **605** includes two pulleys, a belt, and a guide section, not shown. The two pulleys are rotated by drive force given by a drive source (not shown). The belt stretches between the two pulleys and rotates with the rotation of the pulleys. The guide section moves the sheet exit tray **623** upward and downward along a direction of the rotation of the belt. A side of the sheet exit tray **623** is attached to the belt. The drive control section controls the drive source to cause the lifter **605** to lift up or down the sheet exit tray **623**.

The image forming apparatus **1** allows an operator to configure settings for various types of processing by inputting operation directions through the later-described operation section **47** of the image forming apparatus **1**. The settings for various types of processing refer to a setting for performing the post-printing processing on paper, a setting for performing the bookbinding processing on paper having a printed image transferred thereto, and the like.

Next, electrical configuration of the image forming apparatus **1** including the post-printing processing device **60** will be described. FIG. **2** is a functional block diagram illustrating internal configuration of the image forming apparatus **1**.

The image forming apparatus **1** includes the document reading section **5**, a control unit **10**, an image processing section **31**, an image memory **32**, a sheet conveyance section **411**, the image forming section **12**, an operation section **47**, the post-printing processing device **60**, a facsimile communication section **71**, a network interface section **91**, a hard disk drive (HDD) **81**, and so on.

The document reading section **5** has a scanner section **51** including the above-described reading mechanism **163**. The reading mechanism **163** includes an image irradiation lamp **511** and a CCD sensor **512**. The document reading section **5** reads an image of an original document from the original document by irradiating the original document with light using the image irradiation lamp **511** and receiving light reflected off the original document using the CCD sensor **512**.

The image processing section **31** performs image processing as needed according to image data of the image of the original document read by the document reading section **5**. The image processing section **31** is an example of the stabilization section recited in the appended claims. For example, the image processing section **31** performs the stabilization on image data for quality improvement in a printed image to be formed on paper by the image forming section **12**. The image stabilization is performed on image data to maintain the quality of a printed image to be formed by the image forming section **12**. The image stabilization on image data is for example calibration. The image forming section **12** herein forms an image of an original document read by the document reading section **5** on paper. Image data that has gone through the stabilization by the image processing section **31** is stored in the image memory **32** or output to another section such as the image forming section **12** or the facsimile communication section **71**.

The image memory **32** stores therein image data and the like of an original document read by the document reading section **5**.

The sheet conveyance section **411** includes the pickup rollers **145**, a pair of conveyance rollers **192**, and so on illustrated in FIG. **1**. The sheet conveyance section **411** conveys the paper P loaded on the manual feed tray **141**, or in the paper feed cassette **142**, **143**, or **144** to the image forming section **12**, the pair of ejection rollers **607** leading to the post-printing processing device **60**, and the sheet exit slot **606**.

As described above, the image forming section **12** includes: the image forming units **12**M, **12**C, **12**Y, and **12**Bk; the intermediate transfer belt **125** stretching between the drive

roller **125***a* and the driven roller **125***b*; and the secondary transfer roller **210**. Image data to be output to the image forming section **12** may be for example image data read by the document reading section **5** and image data sent from a client computer or the like within a local area network through the network interface **91**. In the description made with reference to FIG. **2**, the image forming section **12** includes the fixing section **13**. The image forming section **12** is an example of the image forming section recited in the appended claims.

As shown in FIG. **1** as well as in FIG. **2**, the operation section **47** includes a touch panel section and an operation key section. The touch panel section and the operation key section receive directions from a user regarding various types of operations and processing that can be executed by the image forming apparatus **1**. The touch panel section includes a display section **473** such as a liquid crystal display (LCD) with a touch panel.

The facsimile communication section **71** includes an encoding/decoding section, a modulation/demodulation section, and a network control unit (NCU), not shown. The facsimile communication section **71** receives and sends facsimiles through a public switched telephone network. For example, the facsimile communication section **71** sends image data of an original document read by the document reading section **5** to a facsimile machine or receives image data sent from a facsimile machine through the public switched telephone network.

The HDD **81** stores therein image data and the like of an original document read by the document reading section **5**. The image data stored in the HDD **81** is formed into a printed image on paper by the image forming section **12**. The image data stored in the HDD **81** can be sent to a client computer network-connected to the image forming apparatus **1**.

The network interface section **91** includes a communication module such as a LAN card. The network interface section **91** receives and sends various types of data from and to a device (e.g., a personal computer) in a local area network through a LAN connected to the network interface section **91**.

The control unit **10** includes a central processing unit (CPU), RAM, ROM, dedicated hardware circuitry, and so on. The control unit **10** performs overall control of the image forming apparatus **1**. The control unit **10** includes a control section **100**, a sheet interval detection section **101**, a sheet interval determination section **102**, a cumulative time measuring section **103**, and a time determination section **104**.

The control section **100** is connected with the document reading section **5**, the image processing section **31**, the image memory **32**, the sheet conveyance section **411**, the image forming section **12**, the operation section **47**, the post-printing processing device **60**, the facsimile communication section **71**, the network interface section **91**, and the HDD **81**, and performs control of these sections.

The sheet interval detection section **101** detects the sheet interval while the post-printing processing device **60** is performing post-printing processing. The sheet interval refers to a time interval between a trailing end of a preceding sheet of paper P and a leading end of a following sheet of paper P among consecutive sheets of paper P being conveyed in the post-printing processing device **60**. The sheet interval may be a time interval between a trailing end of a preceding original document sheet and a leading end of a following original document sheet among consecutive original document sheets being conveyed.

The sheet interval determination section **102** determines whether or not the sheet interval detected by the sheet interval detection section **101** exceeds a reference period of time.

The cumulative time measuring section **103** measures the cumulative total time taken for the image forming section **12** to perform an image formation operation.

The time determination section **104** determines whether or not the cumulative total time measured by the cumulative time measuring section **103** exceeds a predetermined period of time.

When the time determination section **104** determines that the cumulative total time exceeds the predetermined period of time and the sheet interval determination section **102** determines that the sheet interval exceeds the reference period of time, the control section **100** controls the image processing section **31** to perform the stabilization during the sheet interval determined to be exceeding the reference period of time.

The image forming apparatus **1** according to an embodiment of the present disclosure includes the control section **100**, the sheet interval detection section **101**, the sheet interval determination section **102**, the cumulative time measuring section **103**, and the time determination section **104**.

The control unit **10** operates in accordance with an image processing program installed in the HDD **81** to function as the control section **100**, the sheet interval detection section **101**, the sheet interval determination section **102**, the cumulative time measuring section **103**, or the time determination section **104**. Alternatively, the control section **100**, the sheet interval detection section **101**, the sheet interval determination section **102**, the cumulative time measuring section **103**, and the time determination section **104** may each include hard-wired circuitry, being independent from the operation of the control unit **10** in accordance with the image processing program. The same is true of the following embodiments unless otherwise noted.

Next, the stabilization control in the image forming apparatus **1** including the post-printing processing device **60** will be described with reference to FIGS. **3** and **4**. FIG. **3** is a flowchart illustrating a first half of the stabilization control based on the sheet interval of a plurality of sheets of paper P conveyed to the post-printing processing device **60**. FIG. **4** is a flowchart illustrating a last half of the stabilization control based on the sheet interval of a plurality of sheets of paper P conveyed to the post-printing processing device **60**.

The stabilization is triggered by the image formation time taken for the image forming section **12** to perform an image formation operation. In this control, once the image forming section **12** has started the image formation operation (**51**), the cumulative time measuring section **103** starts measuring the cumulative total of the time taken for the image forming section **12** to perform the image formation operation (S**2**). The cumulative time measuring section **103** accumulates developer actuation time in this control. The developer actuation time refers to a period of time during which the developing device **122** is actuated.

The time determination section **104** determines whether or not the cumulative total time measured by the cumulative time measuring section **103** exceeds a predetermined period of time (e.g., five minutes) (S**3**). When the time determination section **104** determines that the cumulative total time does not exceed the predetermined period of time (No in S**3**), then the time determination section **104** repeats the determination in S**3**. That is, the time determination section **104** determines again whether or not the cumulative total time exceeds the predetermined period of time. On the other hand, when the time determination section **104** determines that the cumulative total time exceeds the predetermined period of time (Yes in S**3**), then the control section **100** determines whether or not the post-printing processing device **60** is performing post-printing processing (S**4**).

When the control section **100** determines that the post-printing processing device **60** is not performing post-printing processing (No in S**4**), then the stabilization control of the present embodiment is completed. That is, when the control section **100** determines that the post-printing processing device **60** is not performing post-printing processing, the image processing section **31** does not perform the stabilization. On the other hand, when the control section **100** determines that the post-printing processing device **60** is performing post-printing processing (Yes in S**4**), then the sheet interval detection section **101** detects the sheet interval (S**5**). In the present embodiment, the image forming apparatus **1** has a plurality of read sensors located upstream of the pair of conveyance rollers **602** in terms of the sheet conveyance direction and disposed along the conveyance path of paper that is conveyed by the post-printing processing device **60**. The sheet interval detection section **101** detects as the sheet interval a time interval between two consecutive sheets of paper being conveyed, that is, a period of time from when a trailing end of the preceding sheet of paper among the two consecutive sheets of paper passes a reading point of each read sensor till when a leading end of the following sheet of paper passes the reading point of the read sensor (detection of the sheet interval).

Next, the sheet interval determination section **102** determines whether or not the sheet interval detected by the sheet interval detection section **101** exceeds a reference period of time (S**6**). The reference period of time is a period of time predetermined as a time needed for the stabilization. When the sheet interval determination section **102** determines that the sheet interval exceeds the reference period of time (Yes in S**6**), then the control section **100** controls the image processing section **31** to perform the stabilization during the sheet interval (S**7**). Then, the stabilization control of the present embodiment is completed. Herein, among the post-printing processing, the post-printing processing during which the sheet interval exceeds the reference period of time is at least one of stapling, punching, sorting, and folding, for example.

On the other hand, when the sheet interval determination section **102** determines that the sheet interval does not exceed the reference period of time (No in S**6**), then the control section **100** determines whether or not a predetermined standby time (e.g., one minute) has elapsed (S**8**). The standby time is set as a period of time during which the image processing section **31** is controlled not to perform the stabilization until the sheet interval exceeds the reference period of time instead of immediately performing the stabilization when it is determined that the cumulative total time exceeds the predetermined period of time (Yes in S**3**) and it is determined that the post-printing processing device **60** is performing post-printing processing (Yes in S**4**).

When the control section **100** determines that the predetermined standby time has not elapsed (No in S**8**), then the stabilization proceeds to S**5**. That is, when the sheet interval does not exceed the reference period of time, the control section **100** controls the image processing section **31** not to perform the stabilization until the predetermined standby time has elapsed. That is, the control section **100** controls the image processing section **31** not to perform the stabilization until the sheet interval exceeds the reference period of time. On the other hand, upon determining that the predetermined standby time has elapsed (Yes in S**8**), the control section **100** controls the image forming section **12** to stop the image formation operation and controls the image processing section **31** to perform the stabilization (S**9**). Then, the stabilization control of the present embodiment is completed.

According to the present embodiment, the stabilization by the image processing section **31** is timed so as to be performed during a period of time during which the post-printing processing device **60** is performing post-printing processing and therefore the sheet interval is long enough for securing time for the stabilization. As a result, spare time of the image forming apparatus **1** that does not contribute to the printing productivity can be effectively used to perform the stabilization on a timely basis without reducing the printing productivity.

According to the present embodiment, the sheet interval determination section **102** determines whether or not the sheet interval detected by the sheet interval detection section **101** exceeds the reference period of time. The time determination section **104** determines whether or not the cumulative total time measured by the cumulative time measuring section **103** exceeds a predetermined period of time. Accordingly, when it is determined that the cumulative total time exceeds the predetermined period of time and it is determined that the sheet interval exceeds the reference period of time, the control section **100** controls the image processing section **31** to perform the stabilization while post-pining processing is being performed.

Furthermore, the present embodiment focuses on an interval between sheets of paper (sheet interval), which gets longer during post-printing processing. When it is determined that the cumulative total time exceeds the predetermined period of time and the sheet interval exceeds the reference period of time during post-printing processing, the control section **100** controls the image processing section **31** to perform the stabilization.

That is, according to the present embodiment, the stabilization is timed so as to be performed during a period of time during which post-printing processing is performed and therefore the sheet interval is long enough for securing time for the stabilization. Accordingly, spare time that does not contribute to the printing productivity can be used effectively. As a result, it is possible to perform the stabilization on a timely basis while preventing reduction in printing productivity.

The stapling, the punching, and the folding have been described as examples of the post-printing processing in the present embodiment. The sorting that involves moving a paper width guide and ejecting sheets of paper into different positions in terms of a direction perpendicular to the sheet conveyance direction can be an example of the post-printing processing. Ejection of paper takes more time in the sorting than in normal printing. Accordingly, a longer interval may be needed between sheets of paper (sheet interval).

Output destination changing in delivering output to a mail box can be an example of the post-printing processing. An image forming apparatus **1** capable of the mailbox delivering has a plurality of trays. The output destination changing involves control to move a distribution guide to change output destinations. When the distance of move of the distribution guide is long (e.g., when the output destination is changed from a tray **1** to a tray **7**), the move of the distribution guide may not be completed within a normal sheet interval. In this case, therefore, a longer sheet interval may be needed.

Printing processing including both printing without stapling and printing with stapling can be an example of the post-printing processing. Such printing processing needs the stapler to move from an HP position (where a user can replace stapler cartridges) to a stapler standby position once a job without stapling has been completed and the processing shifts to a job with stapling. In this case, therefore, a longer sheet interval may be needed.

In the present embodiment, an example of the image forming apparatus **1** equipped with the post-printing processing device **60** has been described in which the stabilization is timed so as to be performed during a period of time during which post-printing processing is performed and therefore a sheet interval is long enough. However, the present disclosure is not limited to the example, and in a configuration in which the image forming apparatus **1** is not equipped with the post-printing processing device **60**, the stabilization may be timed so as to be performed during switching among the paper feed cassettes **142**, **143**, and **144** from which the paper P is sent out.

The configuration and the processing described above with reference to FIGS. **1** to **4** are merely an embodiment of the present disclosure. The configuration and the processing of the present disclosure are not limited to the embodiment.

What is claimed is:

1. An image forming apparatus comprising:

an image forming section that forms a printed image on paper based on image data;

a post-printing processing section that performs post-printing processing on the paper or an original document;

a stabilization section that performs stabilization on image data;

a sheet interval detection section that detects as a sheet interval a time interval between a trailing end of a preceding sheet of paper and a leading end of a following sheet of paper among consecutive sheets of paper being conveyed in the post-printing processing section or a time interval between a trailing end of a preceding original document sheet and a leading end of a following original document sheet among consecutive original document sheets being conveyed in the post-printing processing section while the post-printing processing section is performing the post-printing processing;

a sheet interval determination section that determines whether or not the sheet interval detected by the sheet interval detection section exceeds a reference period of time;

a cumulative time measuring section that measures a cumulative total time of an image formation operation performed by the image forming section;

a time determination section that determines whether or not the cumulative total time measured by the cumulative time measuring section exceeds a predetermined period of time; and

a control section that controls, upon the time determination section determining that the cumulative total time exceeds the predetermined period of time and the sheet interval determination section determining that the sheet interval exceeds the reference period of time, the stabilization section to perform the stabilization during the sheet interval determined to be exceeding the reference period of time.

2. The image forming apparatus according to claim **1**, wherein

the control section controls, upon the time determination section determining that the cumulative total time exceeds the predetermined period of time, the stabilization section not to perform the stabilization until a predetermined standby time has elapsed.

3. The image forming apparatus according to claim **2**, wherein

the control section controls, upon the sheet interval determination section determining that the sheet interval does not exceed the reference period of time and the control section determining that the predetermined standby time has elapsed, the image forming section to stop the image formation operation and the stabilization section to perform the stabilization.

4. The image forming apparatus according to claim **1**, wherein

among the post-printing processing, the post-printing processing during which the sheet interval exceeds the reference period of time is at least one of stapling, punching, sorting, and folding.

5. The image forming apparatus according to claim **1**, wherein

the stabilization is calibration.

6. The image forming apparatus according to claim **1**, wherein

upon determining that the cumulative total time does not exceed the predetermined period of time, the time determination section determines again whether or not the cumulative total time exceeds the predetermined period of time.

7. The image forming apparatus according to claim **1**, wherein

the control section determines whether or not the post-printing processing section is performing the post-printing processing.

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